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(56) Documents cited
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GB 1299234 GB 1207599 GB 1137039

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H1D
Selected US specifications from IPC sub-class H01J

(54) Radioactive-gas detection apparatus comprising an ionization chamber

(57) The apparatus comprises an ionization chamber 6 for continuous detection of α – and β –radiation in gas flows introduced into the sensitive volume of a counter equipped with electrodes 9, 20. The ions generated are detected by electrical means. The sensitive volume of the ionization chamber 6 is defined by a cylindrical meshed electrode 9 in which a collector electrode 20 is arranged in the axial 22 direction. The gas flows are fed from outside into the sensitive volume normal to it and to the electrode configuration 9, 20.

Fig. 1

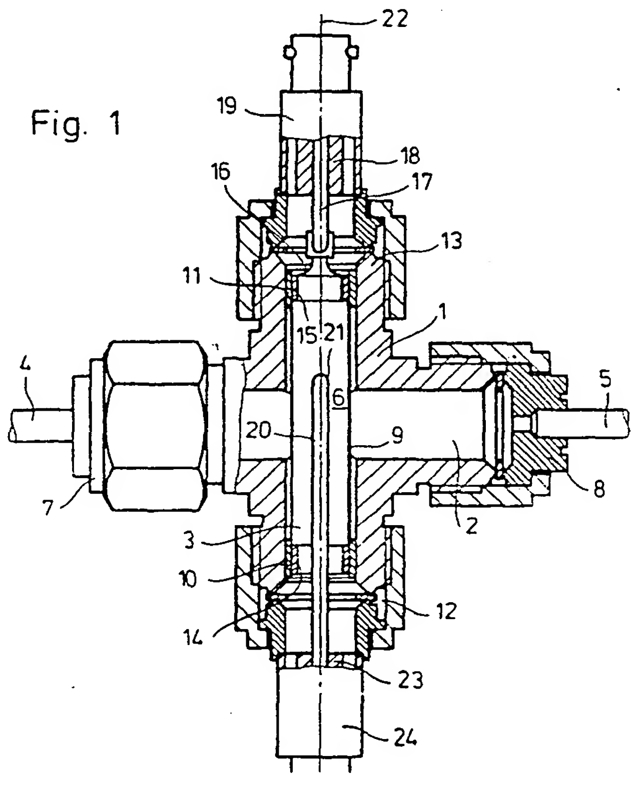


Fig. 1

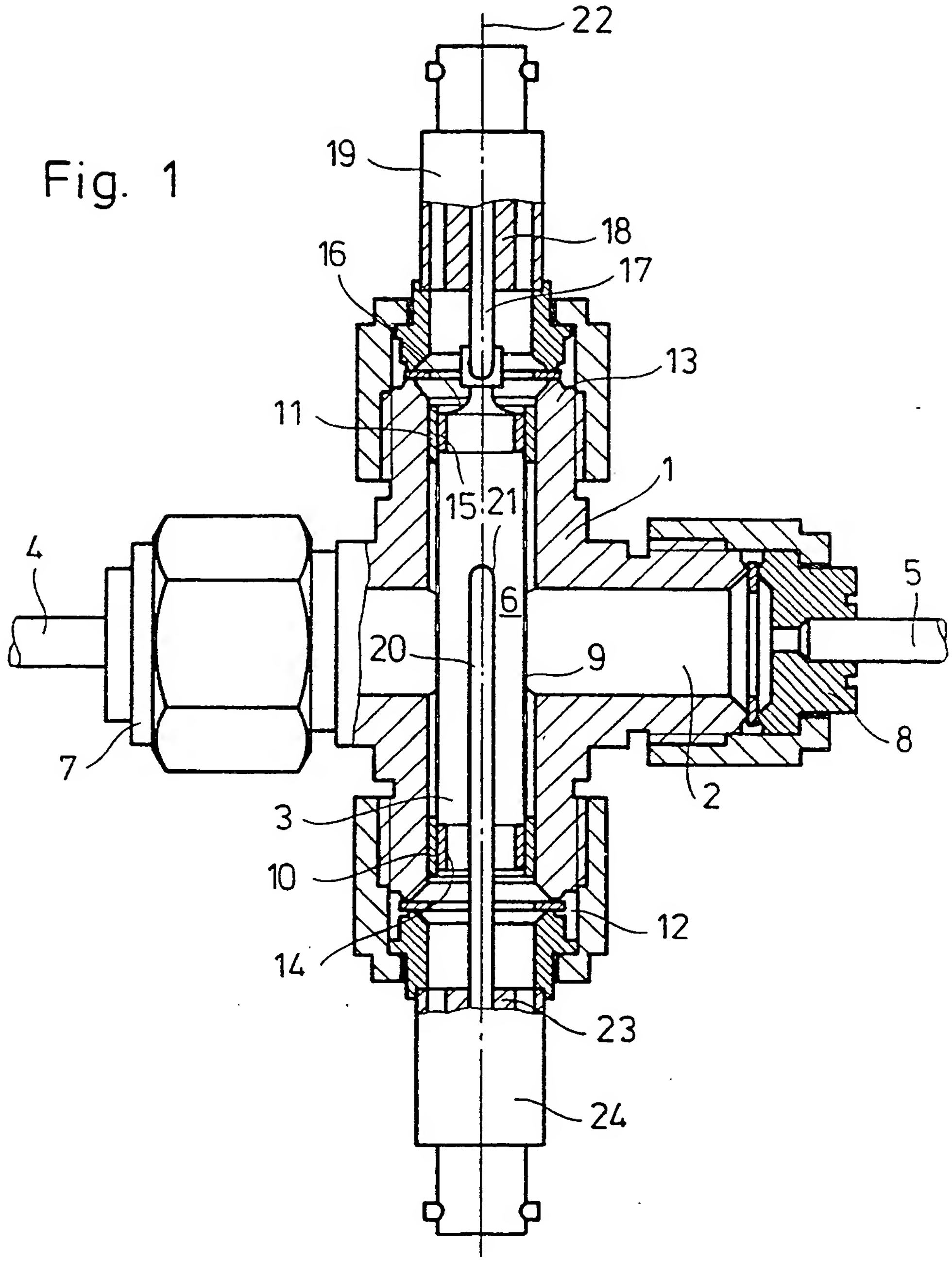
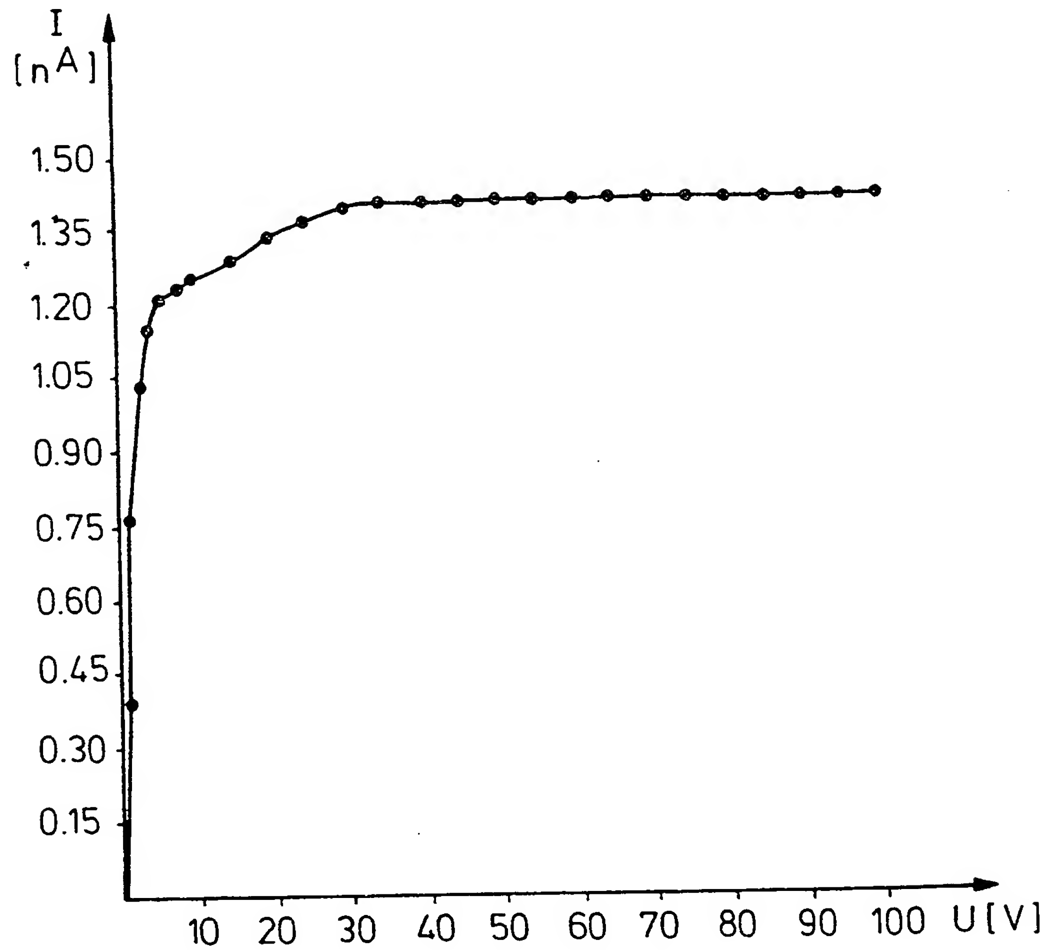


Fig. 2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1.35
1.20
1.05
0.90
0.75
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0.45
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Apparatus Comprising an Ionization Chamber

The invention relates to an apparatus comprising an ionization chamber for continuous detection of α- and β-rays in gas flows fed into a sensitive volume of a counter equipped with electrodes with the ions generated being detected by electric means.

An apparatus of the type mentioned before is known from DE-GM 80 06 812. It is used to detect minimum amounts of tritium in the product gas of a central gas supply system, such as a nuclear coal gasification plant. The product gas in most cases contains methane so that the apparatus, in principle, may be designed as a methane flow counter. For this purpose, counting wires are provided which extend in the direction of the product gas flow and are aligned parallel to each other.

Application of this mechanically complicated apparatus is restricted to low temperatures and its compression strength is not guaranteed. It is practically impossible to determine high tritium, α- or β-activities in gases with a high activity level while achieving, at the same time, a good detection limit with small volumes of the measuring cell.

The task according to the invention consists in designing the aforementioned apparatus in such a manner that it allows to determine α- and β-particles and hence, e.g., the tritium concentrations in gases or gas mixtures also at pressures above 100 bar and at temperatures above 400 °C, and to perform an absolute measurement in pure tritium gas, respectively.

The solution is described in the features specific to claim 1.

The rest of claims comprise advantageous improvements and variants of the invention.

According to the principle realized by the invention of the ionization chamber comprising a very small specific volume, inter alia application can be guaranteed in a large range of pressures covering about 10 orders of magnitude. The detection limit is excellent and lies at 5×10^{-9} Ci/cm³ corresponding to a tritium partial pressure of approx. 2×10^{-6} mbar. Memory effects and leakage flows via ceramic insulations are minimized by optimum utilization of the chamber volume as measuring volume. Moreover, the ionization chamber can be operated permanently at high temperatures (above 180 °C); the structure can be disassembled easily and hence decontaminated conveniently.

The invention will be explained in more detail below by the variant represented in Figs. 1 and 2.

The figure is a cross sectional view of a stainless steel housing 1 with a crosspiece comprising two intersecting channels 2 and 3 preferably oriented normal to each other. The first channel 2 serves to route the gas flow from the gas flow inlet 4 to the gas flow outlet 5 across the area in which the two channels 2 and 3 intersect. The gas flow inlet and outlet 4 and 5 are made preferably in the manner of ultrahigh vacuum tight flanges 7 and 8. The diameter of the channel 3 is preferably 12 mm, that of the channel 2 is smaller and can be adapted to the gas flow.

The essential component is the ionization chamber 6 which, except for the area of intersection, is accommodated in the channel 3. The ionization chamber comprises as its main devices a meshed electrode 9 which, at some distance from the wall of channel 3,is supported at one of the ends 12 and 13 by the insulation rings 10 and 11, respectively, and

internal metal rings 14 and 15, respectively. The meshed electrode 9 comprises a network of a cylindrically welded grid with a wire diameter of 25 µm, a mesh width of 25 µm and 40,000 meshes per cm². This grid is pressed against the ceramic insulations 10 and 11 by the metal rings 14 and 15.

The meshed electrode 9 is supplied a polarizing voltage via, e.g., three wires 16 distributed along the perimeter of the ring 15, the said wires being fastened at the BNC feed-through 17 and, in addition, providing mechanical support to the metal ring 15. The feedthrough 17 is connected with the flange 19 via a ceramic insulation 18 which ensures ultra-high vacuum tightness.

The collector electrode 20 is made in the manner of a pin whose free end 21 extends beyond the area of intersection within the axis 22 of the cylinder bore 3 and the meshed electrode 9, respectively. It is likewise fastened by a ceramic insulation 23 at the flange 24 such as to ensure ultrahigh vacuum tightness.

Both flanges 19 and 24 are preferably bored 3/8" Cajon VCR flanges whose facings are shortened and whose BNC feed-throughs are made in the manner of the feedthrough 17 and the collector electrode 20, respectively.

Figure 2 shows the current(I)/voltage (U) characteristic of the ionization chamber measured at a total pressure of 980 mbar and at a T_2 partial pressure of about 10^{-4} bar. The compression strength has been tested at 100 bar, the tempera ture in permanent operation is preferably 180 °C.

CLAIMS

1. Apparatus comprising an ionization chamber for continuous detection of α- and β-radiation in gas flows introduced into the sensitive volume of a counter equipped with electrodes and with the ions generated detected by electrical means, wherein

   a) the sensitive volume of the ionization chamber ~~(6)~~ is separated from a cylindrical meshed electrode ~~(9)~~ in which

   b) a collector electrode ~~(20)~~ is arranged in the axial ~~(22)~~ direction, and

   c) the gas flows are fed from outside into the sensitive volume normal to it and to the meshed collector electrode configuration ~~(9, 20)~~.

2. Apparatus as defined in claim 1 wherein the cylindrical, meshed electrode ~~(9)~~ is arranged insulated in a channel ~~(2)~~, the gas inlet and outlet ~~(4, 5)~~ are made in the manner of a further channel ~~(3)~~, both channels ~~(2, 3)~~ being capable of forming a crosspiece within a joint housing ~~(1)~~, and with the collector electrode ~~(20)~~ arranged closely to one end ~~(12)~~ of the second channel ~~(3)~~, and the meshed electrode ~~(9)~~ electrically contacted via the other end ~~(13)~~ of the said channel ~~(3)~~.

3. Apparatus as defined in claims 1 and 2 wherein the cylindrical, meshed electrode ~~(9)~~ is supported by a combination comprising an insulation and a press ring ~~(10, 14 and 11, 15, respectively)~~, at each end ~~(12 and 13, respectively)~~ of the second channel ~~(3)~~.

4. Apparatus as defined in claim 1 or in one of the following claims wherein the first channel ~~(2)~~ crosses the meshed electrode ~~(9)~~ approximately in the central area and the collector electrode ~~(20)~~ likewise extends into this area.

5. Apparatus as defined in claim 1 or in one of the following claims wherein the crosspiece is made ultrahigh vacuum-tight.